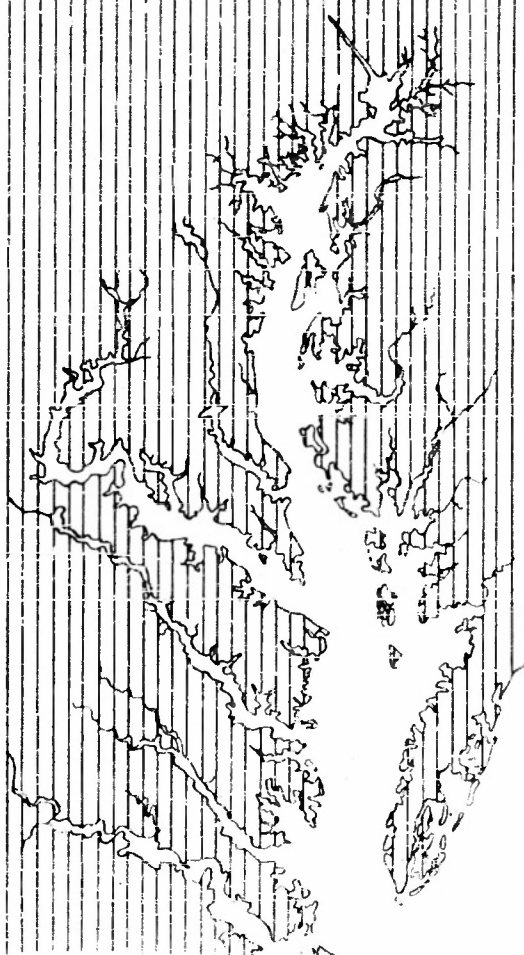


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THE CHESAPEAKE BAY INSTITUTE of The Johns Hopkins University



INSHORE SURVEY PROGRAM
Interim Report XIII

Reference 52-17

CHESAPEAKE BAY INSTITUTE
of
THE JOHNS HOPKINS UNIVERSITY

INSHORE SURVEY PROGRAM

INTERIM REPORT XIII

PART I: BIOLUMINESCENCE IN THE CHESAPEAKE BAY

PART II: NOISE-PRODUCING ORGANISMS IN CHESAPEAKE BAY

By

The Staff of Virginia Fisheries Laboratory

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Project Supervisor

PART I: BIOLUMINESCENCE IN THE CHESAPEAKE BAY

In the animal kingdom, at least 40 orders in 11 phyla contain one or more forms that produce light. In the plant kingdom, only two groups contain luminous forms, the bacteria and the fungi. There seems to be no systematic pattern in the distribution of bioluminescence, for luminous forms appear here and there in quite unrelated groups. One species in a genus may be luminous and another closely related species may produce no light. There is at least one widely distributed species that produces light in some parts of its range and elsewhere contains no trace of luminosity.

A great many luminous forms are marine. Bacteria are abundant in the sea and many of these are capable of producing light. Ordinarily, however, these do not contribute to the phosphoresence of the sea because their mass is relatively small. Such forms are responsible for the luminosity of dead fish or other marine creatures. No fungi occur in the sea. Therefore, bioluminescence in the sea is usually not attributable to plant life.

Luminescent marine animals occur in abundance in Chesapeake Bay. Apparently no detailed study has been made identifying all the light producing organisms that inhabit the Bay, and little is known of their distribution. The following notes on phyla known to include luminous forms, and comments on forms that have been reported from Chesapeake Bay may serve as a guide to further study.

Phylum Protozoa

The Protozoa are unicellular forms that occur in great abundance in the sea. The group contains four classes, two of which are luminous.

Flagellates. - It is believed that practically all the marine species are luminescent. The dinoflagellates, of which more than 40 species have been reported from Chesapeake Bay, undoubtedly contribute to the production of light. During the summer months great patches of "red tide" sometimes appear suddenly and disappear with equal rapidity. This phenomenon has been reported from the lower Potomac and York Rivers, and undoubtedly occurs in many other parts of the Bay. The principal organism in patches of colored water in the lower York in late June 1952 appeared to be Cochlodinium catenatum.

Phylum Coelenterata

The luminescence of hydroids is not too well known, but Aglaophenia, Campanularia, Sertularia, Gonothyrea, Obelia, and Clytia contain some luminescent species. Four of these genera have been identified in Chesapeake Bay. Both the hydroid and the medusa stages may luminesce.

Many jellyfish species luminesce. By far the most common in Chesapeake Bay in summer is the "stinging nettle" (Dactylometra quinquecirrha) which to our knowledge does not produce light. Aurelia and Cyanea are also found in the Bay.

Phylum Ctenophora

The Ctenophores, or "comb-jellies" are exceedingly abundant in the Bay at certain seasons. These organisms have been reported in abundance in January, and again in July, October, and December. The following species are recorded: Beroe ovata, B. forskalli, Pleurobrachia pileus (or P. brunnea), Mnemiopsis gardeni and M. leidy. Members of all three genera are luminescent.

Phylum Annelida

Of the several genera of marine worms that produce light, only Harmothoe and Nereis are listed as occurring in Chesapeake Bay. Another

luminescent genus, Tomopteris, almost certainly occurs in the plankton.

Phylum Arthropoda

Four groups among the Crustacea are known to luminesce, the ostracods, copepods, schizopods, and decapods. Numerous representatives of the first two groups occur in Chesapeake Bay. Five genera of copepods that are known to contain luminous species have been reported from these waters (Corycaeus, Euchaeta, Metridia, Oncaea, Pontella). Some mysids are reported to luminesce, but there appears to be no definite record of the phenomenon in Neomysis americana or Mysidopsis bigelowi, two species that are known to be in the Bay. In addition, many shrimp, both surface-living and deep-sea forms, have luminous organs.

Phylum Mollusca

The boring clams, of the genus Pholas, shoot a luminous secretion out of the siphon. Pholas costata occurs in Chesapeake Bay.

Phylum Echinodermata

The brittle stars are the only luminous members of this phylum. The two species reported from Chesapeake Bay do not belong to the genera that exhibit bioluminescence.

Phylum Chordata

Although many balanoglossids are luminous, Dolichoglossu kowalevski, the only species known from Chesapeake Bay is not.

It has been reported at various times that species of Salpa, Doliolum, and Appendicularia luminesce. It is not known if any of the tunicates or ascidians in Chesapeake Bay produce light.

Although many fishes have highly developed light organs, there are no known luminescent species in Chesapeake Bay.

SUMMARY

Very few details are available on the production of light by organisms in the Chesapeake Bay. It is known that displays of luminescence occur in these waters, and it is probable that the principal producers are the dinoflagellates, the medusae, and the ctenophores. So little information is available on the seasonal and annual variations in abundance of organisms in Chesapeake Bay that it is not possible to estimate the magnitude of variations in light production.

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PART II: NOISE-PRODUCING ORGANISMS IN CHESAPEAKE BAY

The most widespread of all noises of biological origin in the sea is a crisp, high-frequency, crackling noise caused by snapping shrimp. The species of two genera, Crangon (Alpheus), and Synalpheus are capable of vigorous snapping. These benthic animals live mainly below zero tide level. They seek concealment in crevices and holes provided by coral, stones, shells, and other solid objects which makes collecting them very difficult. For this reason their abundance is generally underestimated. Most of the species have been found in water of 30 fathoms or less. They are confined to coastal or shallow water throughout the tropical and sub-tropical regions. In general, the 11°C winter surface isotherm marks the approximate northern and southern limits of their continuous range. Both genera occur in Virginia waters, and they are known to be quite abundant at Beaufort, N. C.

Shrimp noise has its strongest components in the higher frequencies. Above 2000 cycles per second, shrimp noise completely overrides the usual water noise. Above 10,000 cycles per second, it is some 30 db. above the noise of a state 1 sea. When the state of the sea is low, the transmitted shrimp sound is appreciable to a distance of over a mile from the boundary of the shrimp bed.

No seasonal variation in shrimp noises has been detected, but small diurnal variations exist. At night the levels are 2 to 5 db. higher than in the daytime. There are also slight peaks shortly before sunrise and after sunset.

Certain other crustacea are known to make noises similar to those of snapping shrimp. The genera to which these belong, however, are not present in Chesapeake Bay.

The larger crabs have been observed to make noises sounding like the individual crack produced by snapping shrimp. This noise is incidental to the cracking of brittle shells of small clams, and other shellfish used as food. It is probable that the feeding activities of the blue crab (Callinectes sapidus) in Chesapeake Bay may produce some noise, but this should be a rather small contribution to the ambient noise.

Barnacles and perhaps other larger crustacea cause faint noises that may be detected when the hydrophone is very close.

Several species of fishes common in Chesapeake Bay are known to produce sounds. The most abundant group, and the one containing the most species, is the family Sciaenidae, the croakers and drums. The following species grouped by families are found in the Chesapeake Bay:

FAMILY Sciaenidae

Leiostomus xanthurus. - "Spot". The male makes a croaking or drumming sound. Because the drumming muscles are feeble, the sound is not loud. Furthermore, this species is less inclined to school than is the croaker, hence the sound produced is likely to be intermittent. This species is caught in the Bay from April to November, with the largest catches in September and October.

Sciaenops ocellatus. - "Drum", "Red drum".

Caught in the Bay from May to October. Probably most abundant in spring and fall.

Bairdiella chrysura. - "Sand perch". Very abundant. Fished from April to November, most abundant in October. Decreases in abundance from mouth to upper Bay.

Micropogon undulatus. - "Croaker". Usually the most abundant croaker in the Bay. The adults, caught from March to October, make strong drumming noises. The young, which make feebler sounds, live in the Bay throughout the year. The adults move up the Bay in the spring and out to the sea again in the fall.

Pogonias cromis. - "Black drum". Caught from April to December.

Most common in May and November.

FAMILY Otolithidae - weak fishes

Cynoscion nebulosus. - "Spotted weakfish". "Spotted trout".

An important food fish in Chesapeake Bay. Caught from March to December.

Cynoscion regalis. - "Weakfish", "Gray trout". Only the male makes a croaking sound. A valuable food fish in the Bay. Fishing season extends from April to November.

FAMILY Pomadasidae - grunts

Orthopristis chrysopterus. - "Pig fish", "Hogfish". Relatively common in the lower Bay, but not often caught in Maryland waters. Fishing season extends from April to October.

FAMILY Batrachoididae - toadfishes

Opsanus tau. - "Toadfish". Comparatively abundant, and remains in the Bay throughout the year.

FAMILY Ariidae - sea catfishes

Felichthys felias. - "Gaff-topsail catfish", "Sea catfish". Not abundant in Chesapeake Bay, but a few are taken in spring and summer.

FAMILY Triglidae - sea robins or gurnards

Prionotus evolans. - "Sea robin". Occurs in lower part of Chesapeake Bay.

Prionotus carolinus. - "Sea robin". Very common in the Bay.

Seasonal movements not well known. Both sea robin species make chirping sounds.

FAMILY Scombridae - mackerels

Scomber scombrus. - "Common mackerel". The mackerels are said to make noises by means of their pharyngeal teeth. The common mackerel occurs in some abundance in the ocean, but is not common inside the Chesapeake Bay.

In addition to these fish, porpoises are known to make distinct chirping and grunting sounds. These animals sometimes appear in some numbers in the lower Chesapeake Bay and the lower parts of the estuaries, especially in summer.

SUMMARY

Several species of crustacea and fishes known to produce noises occur in the Chesapeake Bay. Many of these are present in rather large numbers, especially during the warmer months. In contrast to the fairly constant high-frequency noise produced by shrimp, fish noises lie in the low frequency range and are markedly seasonal and diurnal. In general, fish noises would be expected more often in summer, and since many of the species are migratory, a definite progression in the production and amount of noise might be expected, beginning at the mouth of the Bay in spring, progressing up-Bay in summer, and receding toward the mouth again in fall.

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APPENDIX

Since the receipt of this report from the Virginia Fisheries Laboratory, the following reference to sound producers in Chesapeake Bay has come to our attention.

Johnson, Martin W. Preliminary survey of certain biological underwater sounds on the East Coast of North America.
University of California, Division of War Research, No. U63, May 25, 1943, File No. 01.33 (NO-163)

Johnson listened for biological noises in the waters near Solomons Island in the center part of the Bay. He reports that during the period of observation (April 3 to 26, 1943) neither fish nor snapping shrimp noises were heard. How much of this observation period was spent in the Chesapeake Bay area is not stated. During the period given, observations were also made at Key West, Florida, Miami, Florida and Beaufort, North Carolina. He refers to:

Eulburt, E. O. An underwater sound of natural origin.
Journal of Acoustical Society of America, Vol. 14,
No. 3, January 1943.

who reported hearing sounds strongly suggestive of shrimp crackling in certain spots near the entrance to the Bay.

The observations of Loye and Proudfoot (1946) indicate that the croaker produces relatively high sound levels with a definite evening and night time maximum in the lower part of the Bay near Ft. Monroe.

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